

**Quickly Enable DOCSIS® 3.0 Functionality
and Counter Telco Market Incursion**

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Quickly Enable DOCSIS® 3.0 Network Functionality and Counter Telco Market Incursion

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The DOCSIS 3.0 specifications enable cable modems to achieve unprecedented uplink and downlink data rates, and it comes not a moment too soon. The growing market strength of telecommunications service providers' fiber-to-the-home (FTTH) services is mounting a significant threat to cable operators, and the race is on to achieve DOCSIS 3.0-network class speeds to stay in the competitive game and win the consumer.

The new DOCSIS 3.0 specification enables cable modems to provide data rates approaching 160 Mb/s downstream and 120 Mb/s upstream to compete with fiber's 100 Mb/s downstream and 100 Mb/s upstream. DOCSIS 2.0 data rates are limited to nominally 40 Mb/s downstream and 30 Mb/s upstream. Never before has time to market been so important to cable modem manufacturers and cable service providers.

One of the top priorities in this race has been the need for a wideband tuner, one that handles the wide IF bandwidth employed in DOCSIS 3.0 and that delivers the performance necessary to achieve reliable data rates.

Fortunately, there is now a single-chip silicon tuner available today with the impressive performance and necessary IF bandwidth required to support DOCSIS 3.0 modems. This drop-in device comes from Microtune, a dominant silicon tuner supplier to the cable market, and its new MicroTuner™ MT2170 wideband tuner is poised to revolutionize the cable modem industry.

THE EVOLUTION OF THE DOCSIS SPECIFICATIONS

In 1999 CableLabs® certified the first cable modems to version 1.0 of the Data-over-Cable-Service-Interface-Specification (DOCSIS). Version 1.1 enabled improved quality-of-service (QoS) for Voice over Internet Protocol (VoIP) telephony with downstream throughput of about 40 Mb/s and upstream throughput of about 10 Mb/s. In 2002, the DOCSIS 2.0 specification boosted the upstream to 30 Mb/s and enabled video conferencing, but five years later a new specification is required to satisfy users' insatiable demand for increased bandwidth. With the new competition from telco providers for these subscribers, it has become imperative that cable operators upgrade their networks and offer new or improved services for faster video downloading/uploading, file sharing, and other bandwidth-intensive applications.

In August 2006, CableLabs responded to the challenge with the DOCSIS 3.0 specification, which uses channel bonding technology to expand cable modem throughput, pushing data rates well over 160 Mb/s, and enabling robust video-over-IP. This new specification is crucial for cable operators to compete aggressively against telcos and other network operators who are now starting to offer broadband data and video services in their areas.

MARKET FORCES

Ample opportunity remains for providers in the cable modem market as it evolves worldwide. While market penetration in the U.S. is already relatively high, the market for cable modems is growing noticeably in other regions, especially Holland, Germany, and Asia. In terms of DOCSIS 3.0, ABI Research expects penetration of DOCSIS 3.0 cable modem termination system (CMTS) infrastructure equipment to reach about 60 percent by 2011, while penetration of DOCSIS 3.0 CPE (modems, set-top boxes, etc.) will be just under 40 percent¹.

Around the world, cable operators are competing like never before with telecommunications service providers. For instance, in Korea, cable broadband access is not as prevalent as DSL service, and video-over-DSL systems are already deployed in that country. DSL is also strong in France and Italy.

In all likelihood, however, fiber-to-the-home (FTTH) or fiber-to-the-premises (FTTP) is the greatest threat to the success of cable operators. In Japan, for instance, the government has initiated a FTTP program, and in the U.S., companies such as Verizon have engaged in aggressive neighborhood-to-neighborhood campaigns to sign-up customers.

Before DOCSIS 3.0, cable operators did not have what they needed to compete with the telecommunications service providers at peak data rates above 40 Mbps. To be successful, cable operators must rapidly deploy competitive services to retain subscribers and attract new ones. As DOCSIS 3.0 services roll out, providers can now deliver video-over-IP across systems up to 1GHz. This will enable a wider, higher-speed IP pipeline for faster up and downstream data as well as for other bandwidth-intensive services. DOCSIS 3.0 can also add new high-bandwidth IP capabilities beyond DOCSIS Set-top Gateway (DSG) already available in set top boxes, which will result in a cable set-tops that can deliver true video over IP.

DOCSIS 3.0 TECHNICAL CHALLENGES

A conventional DOCSIS 2.0 cable modem accepts nominally 40 Mb/s input data in a 6-MHz radio frequency (RF) channel, passes it through a cable modem, and outputs the 40 Mb/s of data (Figure 1). These systems typically operate at up to 860 MHz and support 133 channels. All of the technical challenges for these systems were worked out long ago.

In order to enable rapid deployments, pre-DOCSIS 3.0 cable modem implementations used four conventional tuners (Figure 2). Here the input data was split into four nominal 40 Mb/s segments, sent through separate 6-MHz RF channels to separate single-channel tuners, and the data was recombined to deliver a 160 Mb/s output. This approach enables rapid time-to-market for systems with DOCSIS 3.0 throughput, but is not the optimal long-term solution in terms of component costs and footprint.

¹ <http://www.abiresearch.com/abiprdisplay.jsp?pressid=710>

FIGURE 1: DIAGRAM OF A CONVENTIONAL CABLE MODEM

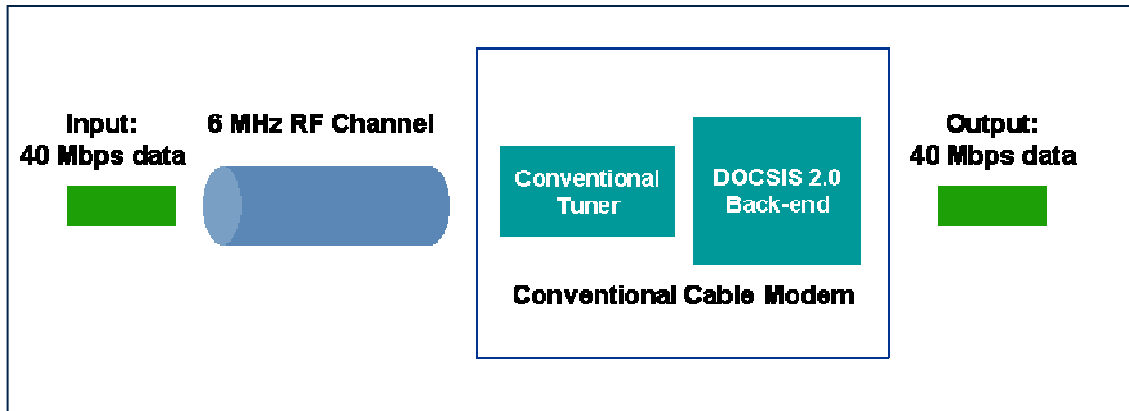
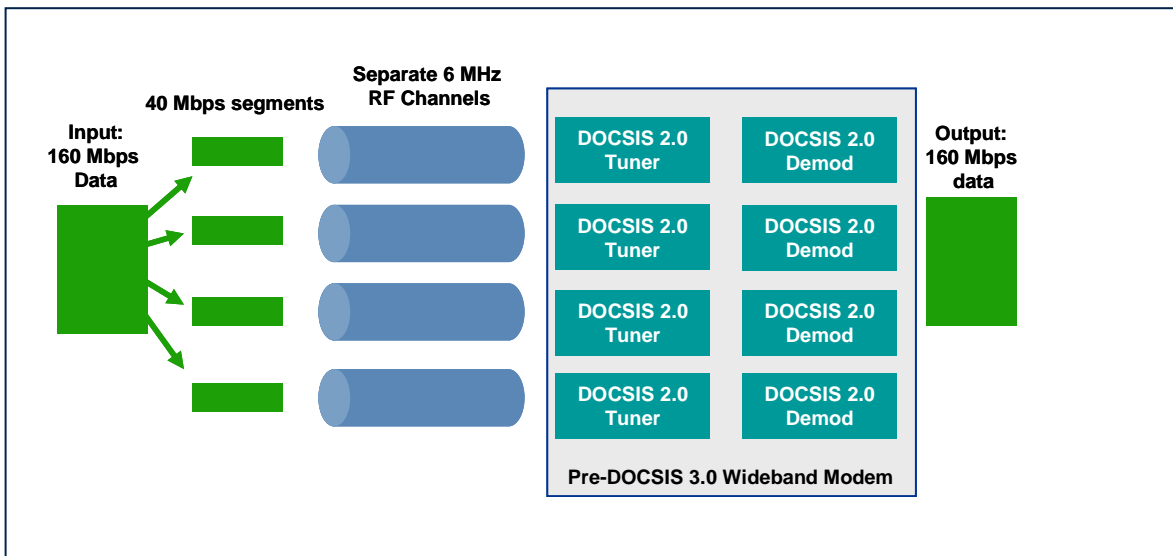
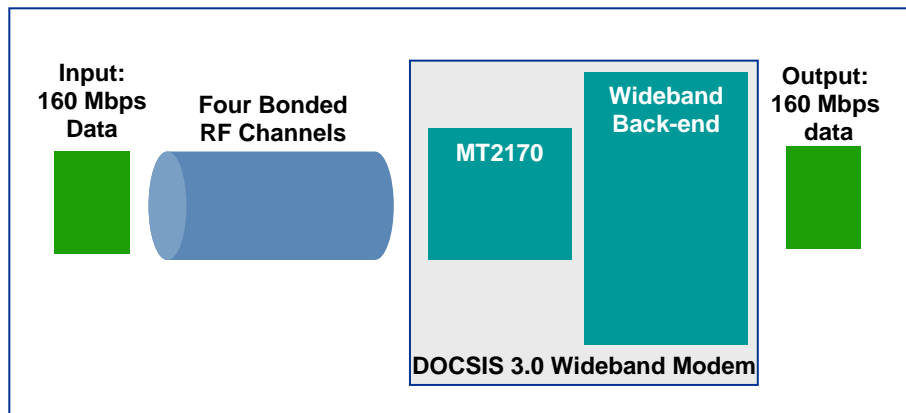


FIGURE 2: PRE-DOCSIS 3.0 MODEM USING CONVENTIONAL DOCSIS 2.0 TUNERS



The better implementation is to use a single wideband tuner, such as the MicroTuner MT2170, to take advantage of IF channel bandwidths of 64 MHz or greater. Figure 3 shows this approach, where 160 Mb/s input data is sent through four bonded RF channels into a single wideband modem tuner to deliver 160 Mb/s output. The MT2170 tuner will operate at up to 100 MHz IF bandwidth, which will enable operators to offer new bandwidth-intensive services.

FIGURE 3: DOCSIS 3.0 MODEM WITH A SINGLE-CHIP WIDEBAND TUNER



"Channel bonding" is a unique feature for DOCSIS 3.0. This approach enables content to be split across multiple RF channels to create more efficient load balancing or peak load bandwidth management than previously available in DOCSIS 2.0. The data streams fit into four channels positioned anywhere within a 64-MHz to 100-MHz bandwidth, depending on the demodulator utilized. The data is sent across the cable plant and it is recombined by the backend processor. This is a similar technology to packet-based IP transmission, except that for DOCSIS 3.0 the data is also broken up in frequency.

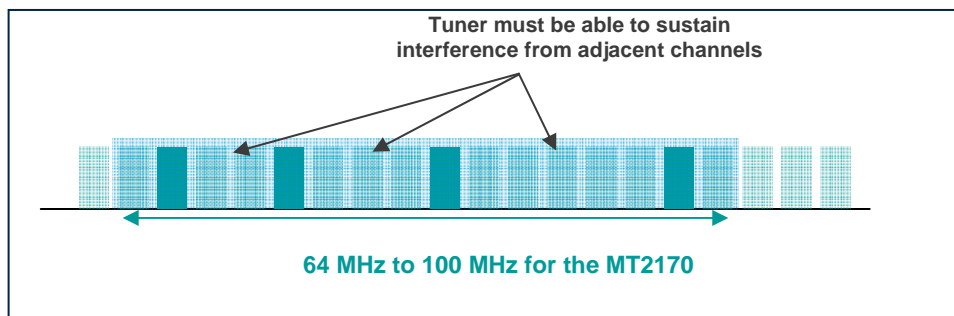
Channel bonding for DOCSIS 3.0 can take a variety of forms. For instance, quad-channel bonding using contiguous blocks of channels results in a bandwidth of 24 MHz, but it limits the operator to the spectrum available in those four channels.

Bonding using non-contiguous channels gives operators more flexibility in using available spectrum (Figure 4), but the tuner must be robust enough to withstand adjacent channel interference.

TECHNICAL CHALLENGES FOR THE TUNER

The MicroTuner MT2170 wideband tuner addresses the technical challenges that face the tuner in a DOCSIS 3.0 environment, and it is uniquely positioned to enable the next generation of wideband cable modems.

FIGURE 4: TUNER MUST WITHSTAND WIDEBAND INTERFERENCE



The major technical challenges for the DOCSIS 3.0 tuner include:

- Extended tuner range: DOCSIS 2.0 spanned 88 to 860 MHz while DOCSIS 3.0 covers 108 up to 1 GHz.
- More channel loading: There will be 155 channels in DOCSIS 3.0 systems as compared to 133 channels in previous systems.
- Broader channel bandwidth: 64 MHz -100 MHz bandwidths in the new systems versus 6 MHz in previous generations.
- Increased downstream throughput: Nominally 160 Mb/s as compared to 40Mb/s with DOCSIS 2.0.
- Enable channel bonding: Pre-DOCSIS 3.0 solutions require multiple narrowband tuners; for a wideband single tuner implementation, the wideband tuner must withstand the adjacent channel interference in non-contiguous channel bonding.

MICROTUNER MT2170 TUNER

The chief advantages of the MicroTuner wideband MT2170 tuner are that it offers up to 16 times the bandwidth of today's typical cable pipeline into the home. It operates up to 1 GHz, and supports channel bonding technology, accepting up to four RF channels within any 100-MHz bandwidth.

As compared to multi-tuner approaches, the MT2170 is a highly integrated single-chip tuner that reduces power consumption by approximately 75% as well as overall RF footprint, resulting in a significant reduction in total solution bill of materials (BOM). Supporting data and video streams with downstream rates of up to 160 Mb/s, it offers cable modem manufacturers an easy, reliable, and cost-effective way to implement DOCSIS 3.0.

Microtune participated in CableLabs' DOCSIS 3.0 specification development and served on the DOCSIS 3.0 committee to define the specification. The resulting MT2170 tuner was specifically designed for DOCSIS 3.0 applications, and the device handles highly compressed digital data in the presence of noise and strong adjacent channel interferers. In addition, it maintains low output distortion even with high output levels.

The MT2170, available today, is the first product in Microtune's new family of tuners designed to support the DOCSIS 3.0. industry specifications and will be a key enabler for popular consumer applications and commercial business offerings, including fast high-definition video downloads, video file exchanges, time-shifted and place-shifted video, high-bit rate services, Internet-Protocol (IP) voice and interactive on-line gaming.

In addition to higher throughput, the MT2170 tuner differs technically from DOCSIS 2.0 predecessors in that it operates in extended-frequency cable networks and supports the rapidly growing consumer demand for capacity-heavy services such as HDTV programming, and time-shifted and place-shifted video.

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DOCSIS 3.0 is a series of industry specifications that enable cable operators to offers significantly higher data rates to their broadband customers.
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